S4 1 PN="EP 108308"
?t 4/5/1

4/5/1
DIALOG(R)File 351:Derwent WPI

003983199
WPI Acc No: 1984-128743/ **198421**
XRPX Acc No: N84-095273

Photoelectric conversion appts. e.g. line image sensor - eliminates noise generated by analog switches between photoelectric elements and common output line

Patent Assignee: TOKYO SHIBAURA DENKI KK (TOKE)
Inventor: HIRAMATSU K; ISHIDA T; KIZU S; MIURA J
Number of Countries: 008 Number of Patents: 006
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
EP 108308	A	19840516	EP 83110484	A	19831020	198421	B
JP 59086379	A	19840518	JP 82195572	A	19821108	198426	
US 4600843	A	19860715	US 83546191	A	19831027	198631	
KR 8800666	B	19880420				198841	
EP 108308	B	19900103				199002	
DE 3381074	G	19900208				199007	

Priority Applications (No Type Date): JP 82195572 A 19821108
Cited Patents: A3...8712; No-SR.Pub; US 4145721; US 4287441; US 4511804
Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
EP 108308	A	E	18		
Designated States (Regional): DE FR GB IT NL					
EP 108308	B	E			
Designated States (Regional): DE FR GB IT NL					

Abstract (Basic): EP 108308 A

The apparatus has an array of photoelectric conversion elements (11-1n). Analog switches (31-3n) are connected between a common output line (4) and the photoelectric elements. A pulse generating circuit produces scanning pulses (O-On). The pulses scan the switches to read out the image signal components on the common output line in succession by turning ON each switch for a predetermined period. An arrangement (O1N) turns ON a switch during first (TA) and second (TB) time periods during a predetermined period in which the switch is scanned by a scanning pulse.

An arrangement (CV,5,6) obtains a signal (es1) during the first period (TA) which contains the image signal component and a noise signal component (eN1). A signal obtained during the second period (TB) includes only the noise signal component. An arrangement holds the first signal (eS1) for a predetermined period. An arrangement (13) produces the image signal component by subtracting the second signal (eN1) from the first (es1). The apparatus eliminates noise signals normally generated during switching of the analog switches. Useful as e.g. a linear image sensor in an optical character reader or facsimile apparatus.

3/4

Title Terms: PHOTOELECTRIC; CONVERT; APPARATUS; LINE; IMAGE; SENSE; ELIMINATE; NOISE; GENERATE; ANALOGUE; SWITCH; PHOTOELECTRIC; ELEMENT; COMMON; OUTPUT; LINE
Index Terms/Additional Words: OCR; FACSIMILE
Derwent Class: P81; U13; W02
International Patent Class (Additional): G02B-007/00; H01J-040/14; H01L-027/14; H04N-001/40; H04N-005/30
File Segment: EPI; EngPI

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 108 308
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 83110484.9

(22) Date of filing: 20.10.83

(51) Int. Cl.³: H 04 N 1/40

(30) Priority: 08.11.82 JP 195572/82

(43) Date of publication of application: 16.05.84 Bulletin 84/20

(84) Designated Contracting States: DE FR GB IT NL

(71) Applicant: TOKYO SHIBAURA DENKI KABUSHIKI KAISHA
72, Horikawa-cho Saiwai-ku
Kawasaki-shi Kanagawa-ken 210(JP)

(72) Inventor: Kizu, Shuji
628-B-9-209, Noba-cho
Konan-ku Yokohama-shi(JP)

(72) Inventor: Ishida, Tsuyoshi
16-3, Hirakawa-cho
Kanagawa-ku Yokohama-shi(JP)

(72) Inventor: Hiramatsu, Kenichi
2-12-504, Nijigaoka-Danchi 2 Nijigaoka
Aso-ku Kawasaki-shi(JP)

(72) Inventor: Miura, Junji
3-7-2, Shiomidai
Isogo-ku Yokohama-shi(JP)

(74) Representative: Patentanwälte Henkel, Pfenning, Feiler, Hänzel & Meinig
Möhlstrasse 37
D-8000 München 80(DE)

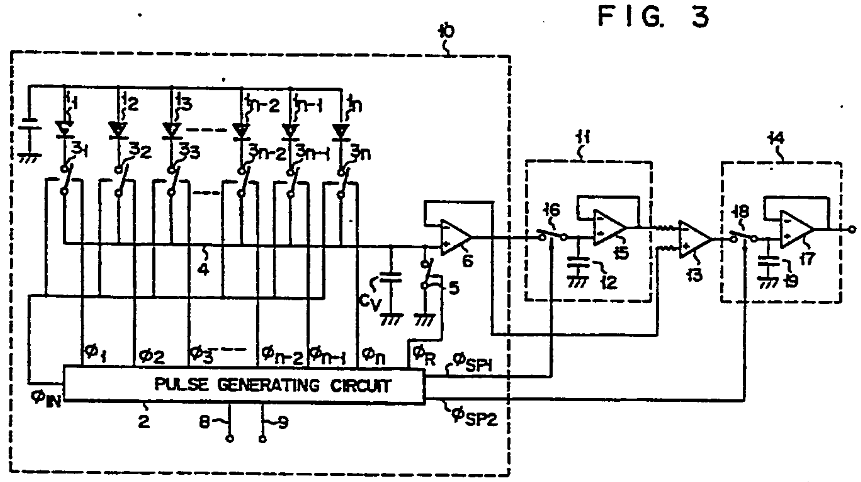
(54) Photoelectric conversion apparatus.

(57) Analog switches (3_1 to 3_n) are connected between corresponding photodiodes (1_1 to 1_n) and a common output line (4). The analog switches are sequentially scanned in response to scanning pulses (ϕ_1 to ϕ_n). During the ON period of each scanning pulse, the corresponding analog switch is turned on twice. A first circuit (C_V, 5, 6, ϕ_R) produces a first signal, including an image signal component and a noise signal component, when the analog switch is turned on for the first time, and produces a second signal including only the noise signal component, when the analog switch is turned on for the second time. A second circuit (11, 13) produces the signal derrived from the difference between the first and second signals, i.e., the image signal.

./...

EP 0 108 308 A2

FIG. 3



Photoelectric conversion apparatus

The present invention relates to a photoelectric conversion apparatus which includes a plurality of linearly arranged photoelectric conversion elements and is used, for example, as a linear image sensor.

In an optical character reading apparatus or a facsimile apparatus, the linear image sensor used receives reflected light from an object to be read out and converts the incident light into electric signals. The linear image sensor includes a photoelectric conversion element array of a number of linearly arranged photoelectric conversion elements, and a circuit for reading out electric image signals from the respective photoelectric conversion elements. The conventional photoelectric conversion apparatus shown in Fig. 1 includes a photoelectric conversion element array of a number of linearly arranged photoelectric conversion elements, e.g., photodiodes 1_1 to 1_n; and a circuit device for sequentially reading out the electric image signals from the respective photodiodes. The circuit device includes a common output line 4; analog switches 3_1 to 3_n which comprise, e.g., MOSFETs, and are respectively connected between the common output line 4 and the photodiodes 1_1 to 1_n; and a pulse generating circuit 2 for generating scanning pulses ϕ_1 to ϕ_n and an inhibit pulse ϕ_{IN} for use in controlling the ON/OFF

operation of the analog switches 3_1 to 3_n. The sensor further includes a signal processing circuit which reads out the signals from the photodiodes 1_1 to 1_n onto the common output line 4, and then produces the signals as a video signal 7. The signal processing circuit includes a capacitor C_V connected to the common output line 4 and ground; an analog switch 5 connected between the common output line 4 and ground, the ON/OFF operation of which is controlled by a clear pulse ϕ_R from the pulse generating circuit 2; and an operational amplifier 6 connected to the common output line 4. If it is assumed that only the photodiodes 1_1 to 1_5 are arranged in the apparatus shown in Fig. 1, the timings of the pulses generated by the pulse generating circuit 2 and the timings of the signals read out on the common output line 4 hold the relationship shown in Fig. 2. Referring to Fig. 2, the scanning pulses ϕ_1 to ϕ_5 have a pulse width T and sequentially and repeatedly scan the analog switches 3_1 to 3_5 (Figs. 2A to 2E). When the time period for completing one scanning cycle in accordance with scanning pulses ϕ_1 to ϕ_5 is defined as a one line scanning time period, each diode stores a charge in response to the project light intensity during this one line scanning time period. For example, to prevent a simultaneous turn-on of analog switches 3_1 and 3_2 when scanning pulse ϕ_1 is switched to scanning pulse ϕ_2, an inhibit pulse ϕ_{IN} (Fig. 2F) which is synchronous with the switching timing from pulse ϕ_1 to pulse ϕ_2 is applied to the analog switches 3_1 to 3_5. In the time period in which the inhibit pulse is applied, the analog switches 3_1 to 3_5 are turned off. When T1 is the rising time of the scanning pulse ϕ_1, T5 is the falling time thereof, T2 is the falling time of the inhibit pulse ϕ_{IN} at time T1, and T4 is the rising time of the inhibit pulse ϕ_{IN} corresponding to time T5, the analog switch 3_1 is turned on from the time T2 to T4. Then, charge from the photodiode 1_1 is

read out onto the common output line 4 from the time T2 to T4. The charge is charged on the capacitor C_V connected to the common output line 4. The charge time constant τ of the capacitor C_V is about $0.7C_V \cdot r$ where r is the ON resistance of the analog switch 3_1. Since the clear pulse ϕ_R rises at the time T3 and the analog switch 3_5 is turned on, the charge on the capacitor C_V is discharged in the time interval between the times T3 and T5. Then, the operational amplifier 6 produces a video signal 7, i.e., the video signal e_{S1} shown in Fig. 2I, from time T2 to T3. The pulse generating circuit 2 may comprise a shift register, or a counter which receives a start pulse 8 and clock pulses 9. For the sake of simplicity, a description has been made only with reference to pulse ϕ_1. However, the mode of operation for the other scanning pulses ϕ_2 to ϕ_5 remains the same.

The defects of the conventional photoelectric conversion apparatus shown in Fig. 1 will now be described, based on the assumption that the photodiode array only has photodiodes 1_1 to 1_5. The common output line 4 receives the noise signal components as well as the image signal components based on charges stored on the photodiodes. The noise signal components are generated due to the turning on and turning off of the analog switches and gate capacitances of the MOS transistors constituting the analog switches. Accordingly, the noise signals differ for the respective analog switches. Thus, even if the photodiodes 1_1 to 1_5 are not irradiated with light, that is, even in the dark condition, as long as the analog switches are switched, the operational amplifier 6 produces noise signals e_{N1} to e_{N5}, as shown in Fig. 2H. The noise singals have the varied amplitudes shown in Fig. 2H, for the reason given above.

The case wherein uniform light is projected onto the photodiodes 1_1 to 1_5, i.e., wherein bright lighting

conditions are present, may be described as follows. Under such conditions, the amplitudes of the image signals read out from the photodiodes 1_1 to 1_5 must be the same. However, since the corresponding noise signals are added to these image signals, the operational amplifier 6 produces the video signals e_{S1} to e_{S5} shown in Fig. 2I. The ON resistances of the analog switches 3_1 to 3_5 change in accordance with the ambient temperature. Accordingly, variations in the video signals are further enhanced. When such noise signals e_{N1} to e_{N5} are generated, the photoelectric reading of, e.g., slips, becomes unreliable, and the processing of slips becomes impossible.

A primary object of the present invention is to provide a photoelectric conversion apparatus which eliminates noise signals normally generated during the switching of analog switches, and which is capable of producing image signals from photoelectric conversion elements such as video signals.

A photoelectric conversion apparatus according to the present invention comprises an array of photoelectric conversion elements, each of which produces an electric image signal component in response to a projected light; a common output line; a plurality of analog switches, each of which is connected between the common output line and the corresponding photoelectric conversion element; a pulse generating circuit which produces a plurality of scanning pulses, which pulses subsequently scan the analog switches for reading out the electric image signal components on the common output line, in succession, by turning ON each of the analog switches for a predetermined time period; means for turning ON an analog switch during at least a first time period and a second time period, during a predetermined time period in which the analog switch is scanned by a scanning pulse corresponding to the analog switch; first means connected to the common

output line and the pulse generating circuit, for use in obtaining a first signal produced during the first time period which first signal includes the image signal component from a photoelectric conversion element and a noise signal component, and for obtaining a second signal produced during the second time period, which second signal includes only the noise signal component; second means connected to the first means and the pulse generating circuit, for holding the first signal for a predetermined time period; and third means connected to the first means and the second means, for producing the image signal component by subtracting the second signal from the first signal.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram of a conventional photoelectric conversion apparatus;

Fig. 2 shows the waveforms used in explaining the mode of operation of the apparatus shown in Fig. 1;

Fig. 3 is a block diagram of a photoelectric conversion apparatus according to an embodiment of the present invention; and

Fig. 4 shows the waveforms used in explaining the mode of operation of the apparatus shown in Fig. 3.

The preferred embodiment of the present invention will now be described with reference to the accompanying drawings.

Since the same reference numerals which were used in Figs. 1 and 2 denote the same parts in Figs. 3 and 4, a detailed description thereof will be omitted. Referring to Fig. 3, the circuit portion surrounded by a dotted line 10 has substantially the same configuration as that of the apparatus shown in Fig. 1 but differs therefrom in that the frequency of the inhibit pulse ϕ_{IN} and the clear pulse ϕ_R in Fig. 3 is twice that of the apparatus shown in Fig. 1 and that the

pulse generating circuit 2 generates sampling pulses ϕ_{SP1} and ϕ_{SP2}. The apparatus shown in Fig. 3 further includes a first sample hold circuit 11 connected to the output terminal of the operational amplifier (to be referred to as a first amplifier, hereinafter) 6 and to the output terminal of the pulse generating circuit 2; a differential amplifier 13 which receives an output signal from the first sample hold circuit 11, as well as a noise signal component from the first amplifier 6; and a second sample hold circuit 14 which receives an output signal from the differential amplifier 13 and produces an image signal component such as a video signal. The first sample hold circuit 11 includes a second amplifier 15; an analog switch 16 which is inserted between the positive input terminal of the second amplifier 15 and the output terminal of the first amplifier 16, and which is turned on while it is receiving a sampling pulse ϕ_{SP1}; and a capacitor 12 connected between the positive input terminal of the second amplifier 15 and ground. The negative input terminal of the second amplifier 15 and the output terminal of the sample hold circuit 11 are connected to each other. The second sample hold circuit 14 includes a third amplifier 17, another analog switch 18 which is inserted between the positive input terminal of the third amplifier 17 and the output terminal of the differential amplifier 13 and which is turned on while it is receiving a sampling pulse ϕ_{SP2}, and a capacitor 19 which is connected between the positive input terminal of the third amplifier 17 and ground. The negative input terminal of the third amplifier 17 and the output terminal thereof are connected to each other.

Fig. 4 shows the signal waveforms used in explaining the mode of operation of the embodiment shown in Fig. 3 when a photoelectric conversion element array includes elements 1_1 to 1_5. As is apparent from Fig. 4, the

phase relations of pulses ϕ_{IN}, ϕ_R, ϕ_{SP1} and ϕ_{SP2} corresponding to the scanning pulses ϕ_1 to ϕ_5 are the same. The mode of operation of the embodiment shown in Fig. 3 may therefore be described with reference to only a scanning pulse ϕ_1. The rising time of that scanning pulse ϕ_1 is designated by t1, its falling time is designated by t9, and its pulse width is designated by T. Times t2 to t8 are sequentially distributed between times t1 and t9. An inhibit pulse ϕ_{IN} corresponding to time t1 falls at time t2, and an inhibit pulse ϕ_{IN} corresponding to time t9 rises at time t8. An inhibit pulse ϕ_{IN} corresponding to a time point substantially intermediate during the time period T rises at time t4 and falls at time t6. Therefore, the analog switch 3_1 is turned on for a first time period TA between the times t2 and t4 and a second time period TB between the times t6 and t8 (Fig. 4F). A first clear pulse ϕ_R supplied to the analog switch 3_1 rises at time t1 and falls at time t2. A second clear pulse ϕ_R rises at time t5 and falls at time t6. Therefore, in the dark conditions (light is not projected onto the photodiode 1_1), the first amplifier 6 produces a noise signal component e_{N1} from the time t2 to t5 and from the time t6 to t9 (Fig. 4H). Under bright conditions (wherein light is projected onto photodiode 1_1), the first amplifier 6 produces a first signal e_{S1} from time t2 to t5, and a second signal e_{N1} from time t6 to t9. The second signal e_{N1} includes only the noise signal component e_{N1}. The first signal e_{S1} includes an image signal component corresponding to the amount of charge stored in the photodiode 1_1, and a noise signal component e_{N1}, as well. The second signal e_{N1} includes only the noise signal component e_{N1}, since the charge stored in the photodiode 1_1 is practically discharged in time interval TA. The pulse width of the sampling pulse ϕ_{SP1} is from time t3 to t4 (Fig. 4J). Therefore, the first signal e_{S1} is sampled and is stored on the capacitor

12 while the analog switch 16 is turned on from time t3 to t4. The output level of the second amplifier 15 is given as e_{S1}, as shown in Fig. 4K. More specifically, the output level from the second amplifier 15 is kept at the level of the first signal e_{S1} until the rising time of the sampling pulse ϕ_{SP1} corresponding to the scanning pulse ϕ_2 (Fig. 4K). In the period in which the first signal e_{S1} shown in Fig. 4K is supplied to the negative input terminal of the differential amplifier 13, the noise signal component e_{N1} is supplied from the output terminal of the first amplifier 6 to the positive input terminal of the differential amplifier 13 from time t6 to t9. Therefore, the differential amplifier 13 produces a signal $e_{S1} - e_{N1}$, i.e., an image signal from the photodiode 1_1, which signal does not contain the noise signal component e_{N1}. This image signal is charged on the capacitor 19, through the analog switch 18, by a sampling pulse ϕ_{SP2} (Fig. 2L) having a pulse width of from T7 to T8. As a result, the image signal $e_{S1} - e_{N1}$ is produced as a video signal $e_{S1} - e_{N1}$ from the third amplifier 14 (Fig. 4M).

For the sake of clarity, a description has been made of the case wherein a video signal $e_{S1} - e_{N1}$ corresponding to the image signal from the photodiode 1_1 is obtained in correspondence with the scanning pulse ϕ_1. However, as may readily be seen from Fig. 4, video signals $e_{S2} - e_{N2}$; $e_{S3} - e_{N3}$; $e_{S4} - e_{N4}$; $e_{S5} - e_{N5}$ which represent the image signals from the photodiodes 3_2 to 3_5 can also be obtained corresponding to the scanning pulses ϕ_2 to ϕ_5. When it is assumed that uniform light is projected onto the photodiodes 1_1 to 1_n, the amplitudes of the resultant video signals become uniform, as shown in Fig. 4M.

As may be seen from the above description, in a conventional photoelectric conversion apparatus, it is difficult to eliminate the noise signal components from

the video signals, these components being introduced as a result of the difference between the ON resistances of the analog switches, the difference between the gate capacitances of the MOS transistors constituting the analog switches, etc.. By way of contrast, video signals from which the noise signals have been eliminated can be obtained in the present invention.

Claims:

1. A photoelectric conversion apparatus comprising:

an array of photoelectric conversion elements (1_1 to 1_n), each of which produces an electric image signal component in response to a projected light;

a common output line (4);

a plurality of analog switches (3_1 to 3_n), each of which is connected between said common output line and the corresponding photoelectric conversion element; and

a pulse generating circuit (2) which produces a plurality of scanning pulses (ϕ_1 to ϕ_n), which pulses subsequently scan said analog switches, for reading out said image signal components on said common output line (4), in succession, by turning ON each of said analog switches for a predetermined time period;

characterized in that said photoelectric conversion apparatus further comprises:

means (ϕ_{IN}) for turning ON an analog switch (e.g., switch 3_1) during at least a first time period (TA) and a second time period (TB), during a predetermined time period in which said analog switch is scanned by a scanning pulse (ϕ_1) corresponding to said analog switch (3_1);

first means (C_V, 5, 6) connected to said common output line (4) and said pulse generating circuit (2), for use in obtaining a first signal (e_{S1}) produced during said first time period (TA), which first signal includes said image signal component from a photoelectric element (1_1) and a noise signal component (e_{N1}), and for obtaining a second signal (e_{N1}) produced during said second time period (TB), which second signal (e_{N1}) includes only said noise signal component (e_{N1});

second means (11) connected to said first means and said pulse generating circuit (2), for holding said first signal (e_{S1}) for a predetermined time period; and

third means (13) connected to said first means and said second means (11), for producing said image signal component by subtracting said second signal (e_{N1}) from said first signal (e_{S1}).

2. A photoelectric conversion apparatus according to claim 1, characterized in that said photoelectric conversion apparatus further comprises fourth means (14) connected to said third means (13) and said pulse generating circuit (2), for sampling said image signal component ($e_{S1} - e_{N1}$) and preserving the sampled value for a predetermined time period in obtaining a video signal.

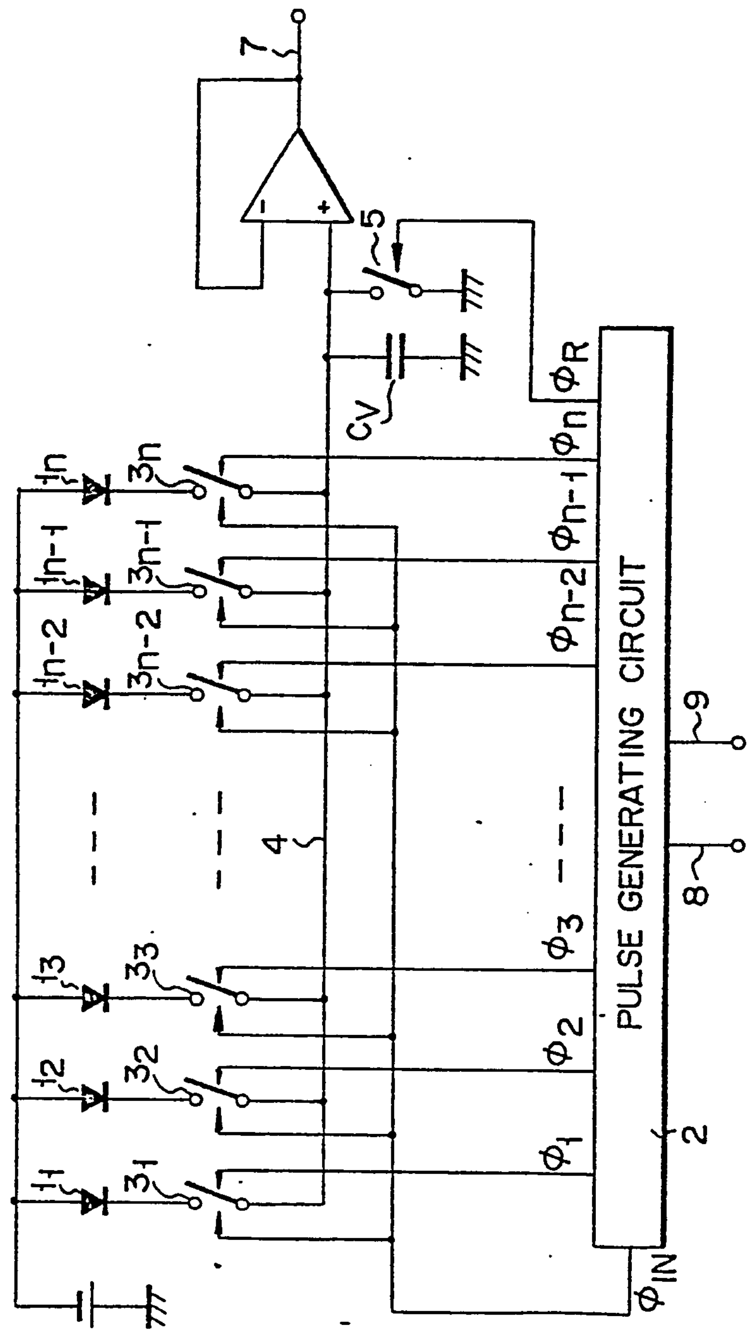
3. A photoelectric conversion apparatus according to claim 1, characterized in that said first means comprises a capacitor (C_V) connected between said common output line (4) and the earth terminal; a first amplifier (6) which is connected at one input terminal (+) to said common output line (4) and at the other input terminal to the output terminal thereof; and an analog switch (5) connected between said common output line (4) and the earth terminal; a clear pulse (ϕ_R) from said pulse generating circuit (2) controlling said analog switch (5) in such a way that said first amplifier (6) produces said first signal (e_{S1}) and said second signal (e_{N1}) at separate timings.

4. A photoelectric conversion apparatus according to claim 1, characterized in that said second means (11) comprises a second amplifier (15) which is connected at one input terminal (+) to the output terminal of said first means, through an analog switch (16), and at the other input terminal (-) to the output terminal thereof; and a capacitor (12) connected between said one input terminal and the ground terminal; a first sampling pulse (ϕ_{SP1}) from said pulse generating circuit (2) controlling said analog switch (16) in such a way that said second means holds the first signal (e_{S1}) for a predetermined time period.

5. A photoelectric conversion apparatus according to claim 1, characterized in that said third means comprises a differential amplifier (13) which is connected at one input terminal (+) to the output terminal of said first means, and at the other input terminal (-) to the output terminal of said second means; said differential amplifier (13) producing an image signal which is produced by subtracting a second signal (e_{N1}) supplied from said first means from a first signal (e_{S1}) supplied from said second means (11).

6. A photoelectric conversion apparatus according to claim 2, characterized in that said fourth means (14) comprises a third amplifier (17) which is connected at one input terminal (+) to the output terminal of said third means, through an analog switch (18), and at the other input terminal (-) to the output terminal thereof; and a capacitor (19) connected between the one input terminal of the third amplifier (17) and the earth terminal; a second sampling pulse (ϕ_{SP2}) from said pulse generating circuit (2) controlling said fourth means in such a way that said fourth means samples said image signal component from said third means, preserving the sampled signal for a predetermined time period, in producing a video signal.

FIG. 1


7
5
CV
φR
φn
φn-1
φn-2
φ3
φ2
φ1
φIN
PULSE GENERATING CIRCUIT
9
8
2
4
1n
1n-1
1n-2
13
12
11
3n
3n-1
3n-2
33
32
31

F I G. 2

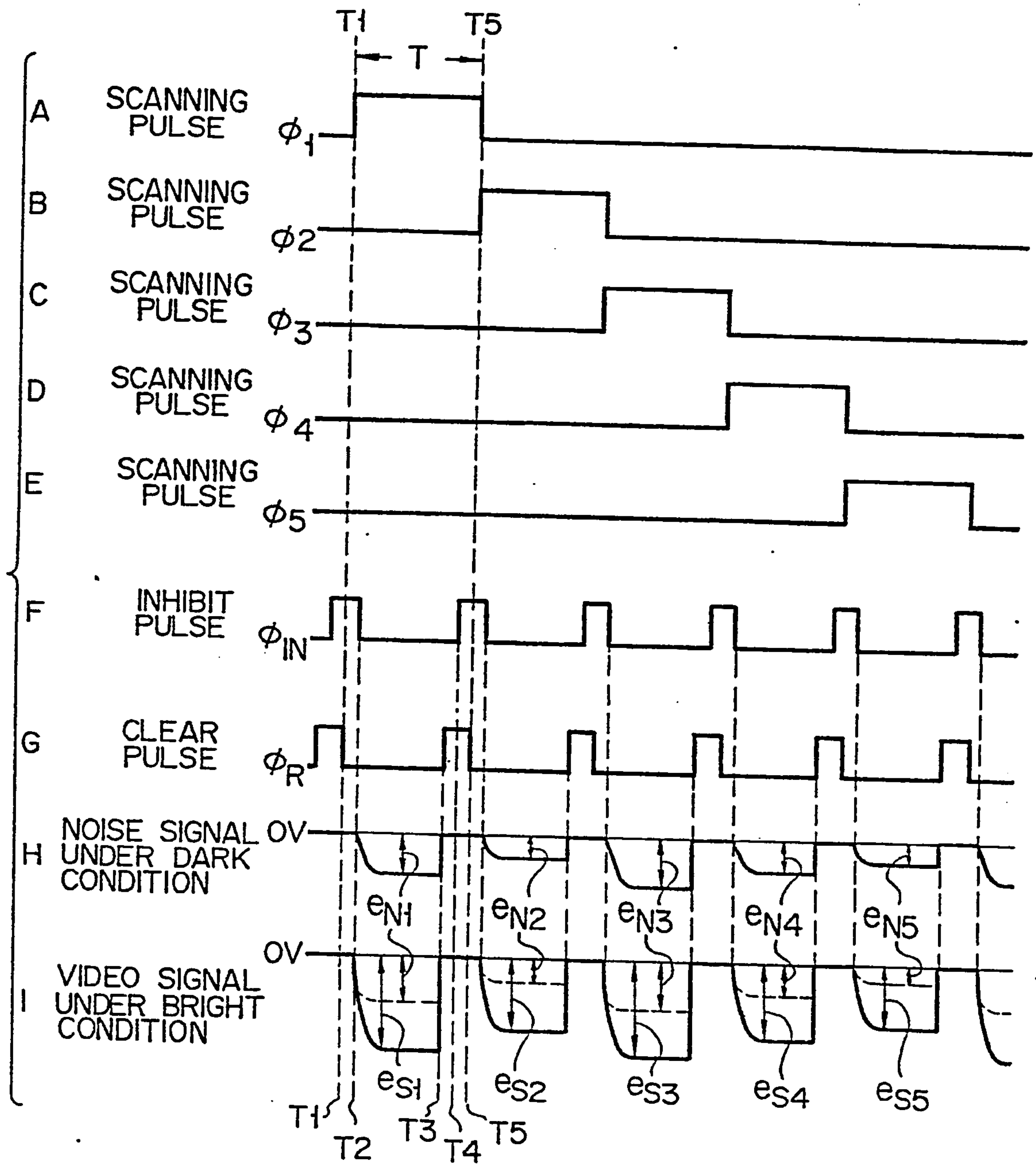
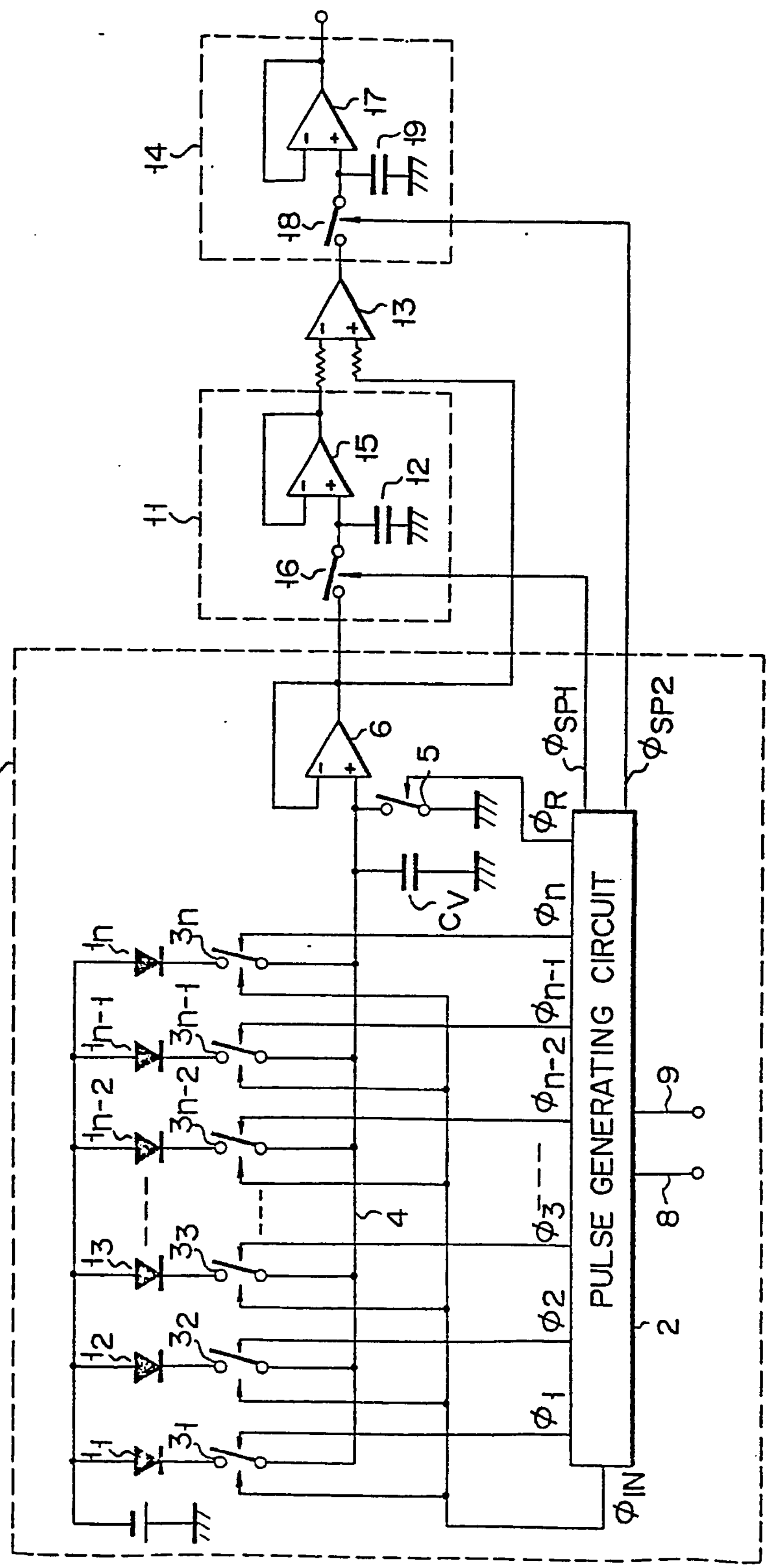

T1
T5
T
A SCANNING PULSE
ϕ_1
B SCANNING PULSE
ϕ_2
C SCANNING PULSE
ϕ_3
D SCANNING PULSE
ϕ_4
E SCANNING PULSE
ϕ_5
F INHIBIT PULSE
ϕ_{IN}
G CLEAR PULSE
ϕ_R
H NOISE SIGNAL UNDER DARK CONDITION
OV
e_{N1} e_{N2} e_{N3} e_{N4} e_{N5}
I VIDEO SIGNAL UNDER BRIGHT CONDITION
OV
e_{S1} e_{S2} e_{S3} e_{S4} e_{S5}
T1 T2 T3 T4 T5

FIG. 3


PULSE GENERATING CIRCUIT
φ1
φ2
φ3
φn-2
φn-1
φn
φR
φSP1
φSP2
φIN
CV

0108308

F I G. 4